Preliminary studies on the early quality identification of *Auricularia auricular*

LI Ling[1], DING Jun-nan[1], LUO Li[1], ZOU Li[1], Wang Xiang-li[2], Zhang Gui-hua[3]
[1] *Northeast Forestry University, Harbin 150040, P. R. China*
[2] *Forest Station of Erheqian Town, Nehe 161348, P. R. China*
[3] *Forest Station of Laha Town, Nehe 161342, P. R. China*

Abstract: In production industry of *Auricularia auricular*, the varieties quality is most important impact factor on output. For evaluating the early quality of the edible fungus, 9 varieties of *Auricularia auricular* (Au9, CF09, CF05, 29, 916, chang10, chang7, Au.Japanese and 8808) were cultured on the medium consists of potato dextrose agar (PDA) and sawdust to test their mycelium growth rate, endurance to high temperature, resistance to mildew, assimilation of nutriment, and resistance to drought. The result showed that the mycelium of Chang 10, CF09, 29 and Au.Japanese varieties had the eminent characteristics such as short lifespan, stronger assimilation of nutriment, and endurance to high temperature and steady growth. These four varieties are determined as superiority varieties of *Auricularia auricular* in accordance with the research results.

Keywords: *Auricularia auricula*; Mushroom; Early quality identification
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Introduction

Auricularia auricular is the main edible fungus species, belonging to the genus *Auricularia*, Auriculariaceae (Yan *et al.* 1999). As one kind of large edible fungi, *A. auricular* is formed by mycelium and hymenium (Bian *et al.* 2000; Zhang *et al.* 2002). During the culturing process of *A. auricular*, degeneration, contamination, confusion and diseases may affect identification for the early quality of the edible fungus (Bian *et al.* 2000; Cheng 2001). However there were few reports on the early quality identification. According to the biological characters of *A. auricular*, we selected some morphological, ecological, and physiological characters as its identification standards, such as mycelium lifespan, assimilation of nutriment, endurance to high temperature, and a steady development rate (Ni *et al.* 2001; Wang *et al.* 2000; Zou *et al.* 1999). In this study, the early quality characters of *A. auricular* was investigated, and the results could be practically used in the early quality identification during culturing process..

Material and method

Materials

Nine varieties of *A. auricular* were selected from microbiological laboratory of Northeast Forestry University, i.e. CF05, CF09, 29, 916, Au9, Chang10, Chang7, 8808 and Au. Japanese. (Fig. 1).

Four species of mildew, including *Rhizopus* spp. 3.866, *Trichoderma* spp. 3.2876, *Mucor* spp. 3.25, *Aspergillus* spp. 3.4523, were taken from the store center of Microbiological Institute, Academy of Sciences of China.

The culture medium consists of Potato Dextrose Agar (PDA) and sawdust in the pure culture of mycelium.

Methods

The varieties of *A. auricular* were inoculated in the core of prepared PDA culture medium plates at 25℃ in the biological incubator and the growth of mycelium was observed every other 24 h for determining the development rate of mycelium.

For testing mycelium endurance to high temperature, each variety of *A. auricula* was inoculated on the core of PDA culture medium plates at 25℃ for a week, incubated at 30℃ for 48 h, after then they were put back to the biological incubator for continuous incubation at 25℃. The situation of mycelium recovery at higher temperature was observed.

For testing mycelium resistance to mildew, each variety of *A. auricular* was inoculated on one third area of PDA culture medium plates at 25℃ for a week, after then a variety of mildew was inoculated on the other side of the same plate. The mycelium resistance to mildew was observed during the incubation.

Assimilation of nourishment was determined by inoculating each of the varieties in test tubes which contained sawdust culture medium in the biological incubator at 25℃. The mycelium growth was measured every other 24 h.

Mycelium resistance to drought was tested by inoculated each of the varieties of *A. auricular* in these tubes with sawdust culture mediums with different moisture percentage (50%, 60%, 65%, 70%) at 25℃.

Three repeats were made for each test and each variety.

Results and analysis

Mycelium development rate

A. auricular has two kinds of developmental stages, i.e. vegetative growth phase and reproductive growth phase. We here calculate the mycelium length of the varieties during the two developmental stages as the indexes of measuring growth rate.

The variety 916 had a longer retarded growth time and began to germinate on the third day after incubation, whereas the other

Foundation item: The research was supported by Science Fund of Northeast Forestry University (2004).
Biography: LI Ling (1964-), female, Engineer in Northeast Forestry University, Harbin 150040, P. R. China. (E-mail: liling66@126.com)
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8 varieties nearly had the same retarded growth time, and they all germinated on the second day. The average growth rate of 9 varieties was 7.0 mm/d. The order of the nine tested varieties (from high to low) in growth rate was Au9, CF09, 29, Chang10, 916, CF05, 8808, Au.Japanese and Chang 7 (Table 1). Considering of the germinate time and growth rate, we recommend Au9, CF09, 29, Chang10 as better varieties of *A. auricular* for practical planting.

Mycelium endurance to high temperature

The mycelium of 9 varieties that were incubated at 30 ℃ for 48 h turned to yellow and did not grow on the first day, after then they were incubated at 25 ℃. The mycelium for species 8808, Chang10, CF05, Au.Japanese and CF09 began to grow on the second day. Until the third day, the mycelium of all the 9 varieties began to grow (Table 2). These results meant that all of 9 varieties had some abilities to endure the high temperature of 30℃, but Chang10, CF05, Au.Japanese and CF09 were better than other varieties in endurance to high temperature at 30 ℃.

Table 1. The length of 9 varieties of *Auricularia auricular* at 25℃ (mm)

Time	Varieties of *Auricularia auricular*								
(day)	8808	Chang10	CF05	29	Japanese	CF09	916	AU9	Chang7
1	-	-	-	-	-	-	-	-	-
2	+	+	+	+	+	+	-	+	+
3	16.0	17.3	14.3	13.3	19.0	14.3	+	11.7	16.5
4	26.7	26.3	24.3	21.0	25.0	25.7	25.0	27.0	26.0
5	36.0	38.0	31.7	33.3	29.7	33.0	29.3	33.0	33.8
6	44.0	46.5	38.0	40.7	37.0	41.0	39.0	42.0	41.0
7	55.0	52.5	49.0	53.7	42.0	51.3	48.0	56.0	46.5
8	62.3	60.0	54.5	57.0	57.0	59.3	60.0	66.0	49.5
Average increase	6.6	7.1	6.7	7.3	6.3	7.5	7.0	9.1	5.5

Notes: "-"----- no bourgeon; "+" ---- bourgeon.

Table 2. The growth of 9 varieties of *Auricularia auricular* after treated at high temperature (30℃)

Time	Varieties of *Auricularia auricular*								
(day)	8808	Chang10	CF05	29	Japanese	CF09	916	AU9	Chang7
1	-	-	-	-	-	-	-	-	-
2	+	+	+	-	+	+	-	-	-
3	+	+	+	+	+	+	+	+	+
4	+	+	+	+	+	+	+	+	+

Notes:"-" -----no recovering growth; "+" -----recovering growth.

Mycelium resistance to mildew

The test of resistances to 4 species of mildew showed that all of 9 varieties had different resistances to different mildews (Table 3). The myceliums of 9 varieties were all covered quickly by mildew *Rhizopus* spp.3.866 and *Trichoderma* spp. 3.2876 (Fig2). The varieties Au.Japanese, 8808, Chang10, CF05, CF09, and Chang7 had some resistance to *Trichoderma* and *Mucor* (Fig 1, 2, 3, 4), while 29, AU9 and 916 had no resistance to the 4 species of mildew, i.e. once they were contaminated by these mildew, their mycelium were covered by the mildew quickly (Fig3, 4).

Table 3. The resistance of 9 varieties of *Auricularia auricular* to mildews

Species of mildew	Varieties of *Auricularia auricular*								
	8808	Chang10	CF05	29	Japanese	CF09	916	AU9	Chang7
Rhizopus 3.866	-	-	-	-	-	-	-	-	-
Trichoderma 3.2876	-	-	-	-	-	-	-	-	-
Mucor 3.25	+ -	+ -	+ -	-	+ -	+ -	-	-	-
Aspergillus 3.4523	+ -	+ -	-	-	+	-	-	-	+ -

Notes:"-"---- no resistance to mildew; "+"---- higher resistance to mildew; "+ -"---- lower resistance to mildew.

Mycelium assimilation of nutriment

The nourishment materials for culturing *A. auricular* mainly are sawdust. The main components of sawdust are macromolecules of cellulose, hemicellulose, lignose and pectic which do not dissolve in water. Those materials can not be assimilated and used by *A. auricular* mycelium directly. Some enzymes must be excreted out from *A. auricular* mycelium to decompose those macromolecules into smaller molecules which can be dissolved in water. Then these smaller molecules can be absorbed by the cells of *A. auricular*. The ability of *A. auricular* to assimilate nourishment can represent its enzymes activities from the mycelium.

The results from Table 4 showed that the variety 916 had a rather longer retarded growth time, and germinated on the forth day after inoculated. Chang10, CF05, Au.Japanese, CF09, Au9, and Chang7 varieties had a relative shorter retarded growth time, and germinated on the second day. But varieties 29 had longer retarded growth time and germinated on the third day. With mycelium germinating, their white mycelium spread to reach the edge the tube. Therefore, the less the time of mycelium reaching the edge of tube was, the stronger ability of assimilation of nutriment was. Comparing the time of varieties reaching the edge of tubes, variety-916, variety-29 and Chang10 had a shortest reaching time (19 days), which meant that they could digest

nourishment quickly (Table 4).

Mycelium resistance to drought

All the 9 experimental varieties could geminate on the culture media with moisture percentage of 70 % and 65 %. While the water content of culture medium decreased to 60%, only 4 varieties such as Chang10, CF05, 29, Au.Japanese and Chang 7 could geminate, furthermore only 3 varieties (Chang10, Au.Japanese and Chang 7) could geminate under conditions of 50% water content (Table5). It is concluded that the varieties Chang10, Au.Japanese, and Chang 7 had the strongest endurance to drought.

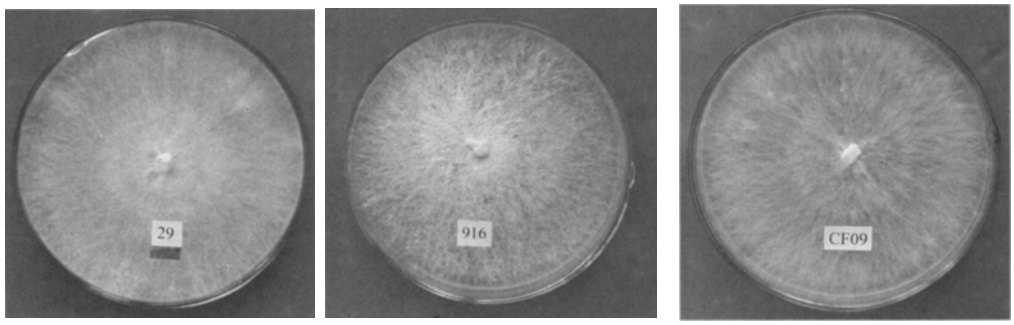

Fig. 1 The varieties 29, 916 and CF09 of *Auricularia auricular*

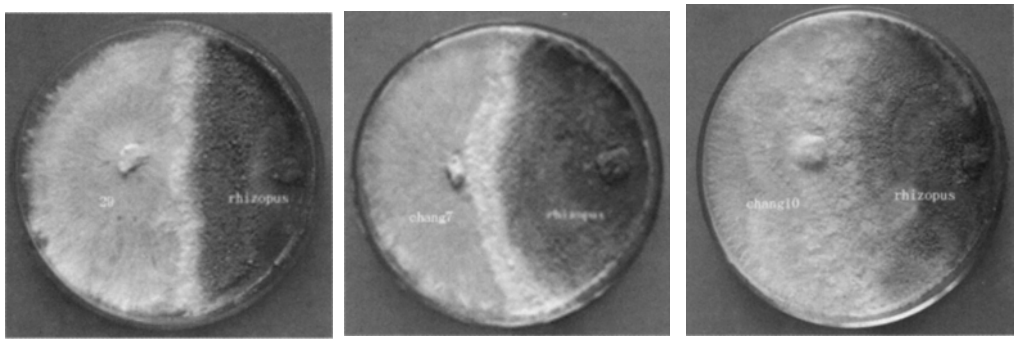

Fig. 2 The resistances of varieties 29, Chang7 and Chang 10 of *Auricularia auricular* to *Rhizopus* spp.

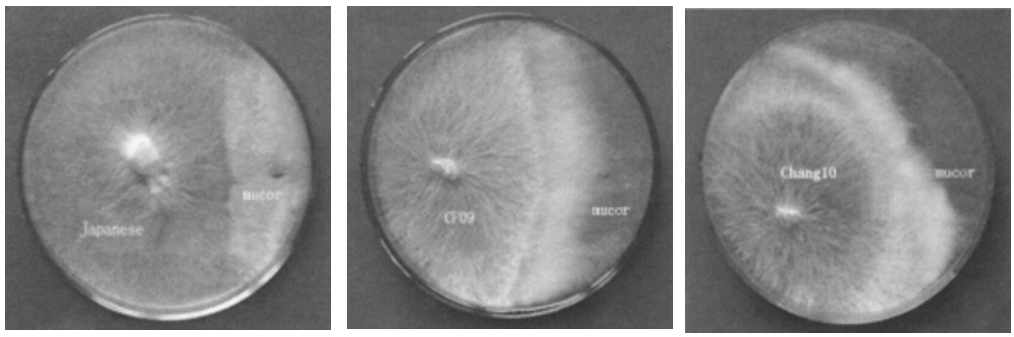

Fig. 3 The resistances of varieties Au.Japanese, CF09 and Chang10 of *Auricularia auricular* to *Mucor* spp.

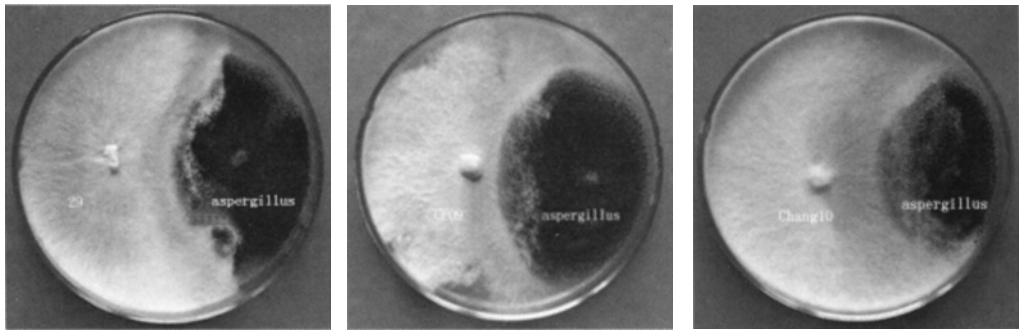

Fig. 4 The resistances of varieties 29, CF09 and Chang10 of *Auricularia auricular* to *Aspergillus* spp.

Table 4. The assimilation nutriment capability of 9 varieties of *Auricularia auricular*

Time (day)	Varieties								
	8808	Chang10	CF05	29	Japanese	CF09	916	AU9	Chang7
1	-	-	-	-	-	-	-	-	-
2	-	+	+	-	+	+	-	+	+
3	+	++	++	+	++	++	-	++	++
4	++	++	++	++	++	++	+	++	++
5	++	++	++	++	++	++	++	++	++
6	++	++	++	++	++	++	++	++	++
7	++	++	++	++	++	++	++	++	++
8	++	++	++	++	++	++	++	++	++
9	++	++	++	++	++	++	++	++	++
10	++	++	++	++	++	++	++	++	++
11	++	++	++	++	++	++	++	++	++
12	++	++	++	++	++	++	++	++	++
13	++	++	++	++	++	++	++	++	++
14	++	++	++	++	++	++	++	++	++
15	++	++	++	++	++	++	++	++	++
16	++	++	++	++	++	++	++	++	++
17	++	++	++	++	++	++	++	++	++
18	++	++	++	++	++	++	++	++	++
19	++	+++	++	+++	++	++	++	++	++
20	++	+++	++	+++	++	+++	++	+++	++
21	++	+++	++	+++	++	+++	++	+++	++
22	+++	+++	+++	+++	++	+++	+++	+++	++

Notes: "-" ---- no germinating; "+"---- germinating; "++" ----growth; "+++" ----mycelium growth reaching the edge of tube.

Table 5. The resistance to drought of 9 varieties of *Auricularia auricular*

Water content (%)	varieties								
	8808	Chang10	CF05	29	Japanese	CF09	916	Au9	Chang7
50	-	+	-	-	+	-	-	-	+
60	-	+	+	+	+	-	-	-	+
65	+	+	+	+	+	+	+	+	+
70	+	+	+	+	+	+	+	+	+

Notes: "-" ---- no germinating observed; "+"---- germinating observed

Conclusions and suggestion

For the nine experimental varieties of *A. auricular*, the varieties, Au9, CF09, 29, Chang10 and 8808, were found to have fast growth, with mycelium growth rate of over 7 mm per day.

The mycelium of varieties 8808, Chang10, CF05, Au.Japanese, and CF09 could resume growth in a short time after high temperature treatment (at 30℃), thus these varieties of *A. auricular* are considered to have strong endurance to high temperature.

The varieties Chang10 and 29 had the strongest ability in assimilation nourishment. The varieties Chang10, Au.Japanese and Chang7 had the strongest ability to endure drought. Those varieties could be planted in a relative arid area. And varieties for Au.Japanese had a relatively stronger ability to resist mildew contamination.

According to the quality experiment on 9 varieties of *A. auricular*, we suggest that Chang10, CF09, 29, and Au.Japanese are 4 eminent varieties for planting.

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